# 2.0 RAINFED SYSTEMS

**Support and encourage processes of change and intensification in rainfed farming landscapes with integrated solutions that mitigate degradation and maintain ecosystem services to serve the needs of those who depend on agriculture for their livelihoods.**

The majority of the world’s poorest people depend primarily on rainfed agriculture for their livelihoods and food security. Many rainfed farming landscapes are very fragile, affected by land degradation, climate risk, and poor infrastructure, contributing to extreme poverty and malnutrition. Smallholder rainfed systems are also under heavy pressure from current and increasing population density.

These rainfed systems are also undergoing rapid change due to a range of local, national and global drivers. For example, climate change will have huge implications for the millions of smallholders who rely on rainfed agriculture in water-scarce areas. Changes in local and regional and even global investment policies and trends have implications for national poverty reduction efforts as well as new challenges for resource management.

The goal of this activity area is to achieve the sustainable intensification of agriculture in rainfed landscapes. It will work in areas where on-going land-use change threatens the environmental foundation upon which agriculture depends, and thus also the welfare of those who depend on the land. Our research will inform a new vision for rainfed landscapes, by providing evidence for how sustainable intensification and mitigating degradation can alleviate poverty and achieve social-ecological resilience. We will provide tools and methods for targeting interventions in landscapes, that account for tradeoffs and synergies amongst ecosystem services and impacts on livelihoods. This research will design new incentives that will enable change in communities and in institutions to achieve better land management.

Our attention to change will look at multiple scales, from local to regional and include global drivers that ‘land’ in local places, to which local people have to adapt. Focus will be both on understanding social and institutional environments to design pathways for change, and the biophysical realities of changes, such as in ecosystem services. Thus this research portfolio will combine analysis of institutions, policy and livelihood portfolios with a focus on biophysical realities and understanding of ecosystem services.

The Intermediate Development Outcome for Rainfed Systems in the Water, Land and Ecosystem Program is therefore that:

**National agencies or development donors and implementers in at least 15 countries use enhanced knowledge of how poverty reduction strategies could have maximum impact across different rainfed farming landscapes to enhance livelihoods without undermining ecosystem services.**

Theory of change

Over the last decade, new and potentially very powerful drivers of change in rainfed systems have emerged. Foreign investment in land, cross border capital including remittances and renewed investment by governments and the private sector, and in line with CAADP policies in sub-Saharan Africa affect land use decisions at various scales. Increased prices of food drive the development of new lands, and the feasibility of food security programs. Investments in hydropower and mining continue to transform ecosystems and landscapes. Poverty Reduction Programs supported by national Governments and international donors have to consider the potential positive or negative impacts of these developments on farming systems, and learn to navigate these drivers and adapt policy and implementation of development interventions to support sustainable outcomes. Our research will allow us to better anticipate environmental challenges and target interventional by forecasting the impact of alternative investment and development interventions. We will bridge the interests of the development and environmental conservation communities to bring about innovation and new solutions.

Rainfed activities will have the following characteristics:

Employing a *social-ecological landscape* approach that grounds specific interventions in the spatial and temporal variability of the landscape, integrates understanding of interactions in space and time amongst interdependent ecosystem services and livelihood strategies, and builds that understanding into decision-making processes through threshold and tradeoff scenarios.

A *transformative knowledge* approach that focuses on tadvocating innovative processes involving active engagement with multiple stakeholders necessary for better planing and implementation of development interventions to build resilience. These approaches must be grounded in an understanding of social and political processes that underlie decision-making..

*Integration of multidisciplinary science and research to* include advanced land and degradation assessment, environmental economics, landscape and ecosystem services modeling tools, and innovative tools for participatory engagement and social learning.

A *Theory of change* embedded in on-going processes, and a focus on areas where changes in policy can be supported by knowledge.

Activity Clusters

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| **Title**  2.1 Reducing land degradation in rainfed landscapes |
| **Problem to be addressed**  At Rio +20 Conference in 2012, the global community set out key principles for sustainable development, one of which was a land-degradation neutral world. This principle will guide renewed efforts to define and monitor progress towards ‘zero net land degradation’ in the coming decades. . New approaches and solutions are needed for many agricultural ecosystems that have suffered decades of progressive degradation resulting in persistently poor productivity as a result of a degradation of ecosystem services such as biomass production, regulation of water cycles, and soil health. Nearly 50% of farmland in Africa suffers from erosion and nutrient depletion. The value of nutrients lost in Africa is estimated at $4 billion per year (CAADP 2009). Other systems are continuing to follow this path today because the problem of degradation remains unappreciated or is masked by increasing inputs.  Slowing or reversing land degradation is a difficult research/impact area as it must (1) tackle the conditions that cause land degradation and (2) provide the incentives for farmers and governments to invest in degraded land. The investment needed to stop or reverse degradation is significant and often out of reach of individual farmers and also involve collective action. Clarifying why, where, and how governments or others can address resource degradation, and the costs of inaction, will be critical in enhancing the productivity of these agroecozones and building resilience into farming communities. New approaches to understand, monitoring and evaluate degradation, and incentive schemes such as pro poor credit schemes, carbon credits, subsidies, and payments schemes for environmental services can provide important opportunities. |
| **Intermediate Development Outcome**   1. Reduced land degradation and increased resilience of smallholder farming communities in target landscapes in sub-Saharan Africa, Latin America and Southeast Asia through policy interventions and incentives. |
| **Research outcomes**   1. Advanced RS/GIS and IR technology for land assessment used to characterize degradation in selected landscapes, and this knowledge built into agricultural development planning strategies in east and southern African nations to reduce or reverse degradation. 2. Surveys of degradation and research in selected landscapes in SSA and Latin America inform decision-makers about causes of degradation and improve targeting of recommendations to recuperate the degraded areas. 3. Appreciation of current trends, particularly in insidious soil fertility loss, and the consequences of ‘business as usual’ influences design of development investment plans. 4. Full cost of degradation of ecosystem services, biodiversity loss, and implications for poverty assessed and understood by stakeholders in selected landscapes and plans and implementation of interventions adapted accordingly. 5. Known and new methodologies and incentives, including payment for ecosystem services schemes are assessed by partners for their suitability to combat degradation in the selected landscapes. |
| **Research outputs**   1. Land degradation and its trends and causes assessed and evaluated, based on new landscape tools for rapid assessments and evaluation of the causes of land degradation. 2. Spatially-explicit integrated solutions to recuperate degraded lands that provide incentives for adoption by smallholder farmers. 3. Incentives designed and processes tested for institutional change to restore degraded landscapes 4. Generic lessons on linkages between degradation, ecosystem services and poverty drawn from case study landscapes. 5. Impacts of degradation and trade-offs amongst services assessed including cost of action vs. non action in restoring land. 6. Engagement at national levels, and with international initiatives and conventions, specifically ELD, UNCCD, and GEF |

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| **Title** 2.2 Sustaining productive landscapes by increasing biodiversity |
| **Problem to be addressed**  The intensification of agriculture often threatens important biological diversity and associated ecosystem services such as fuel and fruit trees, medicinal plants, pollinators, predators and useful belowground organisms. The sustainability of production and livelihoods depend on these services in the long term,. A current debate pits the notion of ‘land-sparing,’ where agricultural production is maximized on cultivated lands, allowing some land to be put aside for biodiversity conservation, against the notion of ‘land sharing’ in which landscape mosaics are thought to ensure the sustainability of agricultural production. It is very likely that neither approach will fit every bill: different circumstances do require different types of intervention, and scale is an important factor. It is important to ensure that agricultural intensification does not compromise biodiversity and associated productivity and resilience in the landscape, but instead conserves or even enhances it.  This activity will study the ways in which both farmed and non-farmed biodiversity can contribute to sustainability of agricultural systems. Expanding diversity by increasing the number of varieties and breeds used in agriculture and by planting trees, for example, can improve resilience and reduce risk. Significant research has demonstrated that in some places schemes for payment for ecosystem services can function and support ecosystem services, although long-term sustainability of these schemes is yet to be demonstrated. As appropriate, this activity will support the development of policies and frameworks to protect access to biodiversity. |
| **Intermediate Development Outcome**   1. Increased agricultural resilience, reduced risk and biodiversity maintained over the long-term by smallholder as well as commercial farmers through adoption of regulatory and management frameworks for maintaining ecosystem services and handling tradeoffs between farmed and non-farmed components of landscapes. |
| **Research outcomes**   1. Government, research partners and communities are involved in design and implementation of the co-management of multi-functional landscapes. 2. Raised awareness and increased knowledge on the role of biodiversity for sustainable agricultural production and ecosystem service production in agricultural development communities. 3. Increased collaboration between conservation NGO’s and agricultural development actors in target landscapes leads to better integration of environmental and livelihood goals. 4. Management of ecosystem services is mainstreamed in development programs in target landscapes. 5. Regulatory frameworks are established or strengthened in landscapes in meso- and Latin America for protected and restricted areas or management activities that support protection of vulnerable lands and ecosystem services. 6. Farmscape management and landscape co-management frameworks for harnessing biodiversity in production of ecosystem services, including ecosystem service incentive mechanisms such as schemes for payment for ecosystem services, adopted by development programs. |
| **Research outputs**   1. Integrated tools and frameworks for assessment and diagnosis of landscape integrity: livelihoods and wellbeing of people; food security and income; composition and structure of the landscape, and ecosystem services, including biodiversity; 2. Analyses and diagnoses of land health, landscape composition and structure as a determining factor for ecosystem functioning and human wellbeing; 3. Models and tools for landscape design; participatory design and implementation of options to diversify and/or maintain diversity while increasing food production in farming landscapes 4. Assessment of the relative advantage of ‘land sparing’ compared with landscape mosaics in supporting rural communities and increased food production in representative landscapes. Participatory methods for landscape and environmental planning; evaluation of options for Payment for Environmental Services and sharing benefits from natural resources. 5. Engagement in international initiatives and conventions, specifically the Ramsar Convention and IUCN, and conservation NGO’s, CI, WI. |

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| Title  **2.3 Reducing risk and tackling productivity/environment challenges in farming landscapes** |
| Problem to be addressed  Increasing the production of food, fiber and fuel is the most obvious need in many smallholder farming landscapes of sub-Saharan Africa. In the short term production can be increased and yield gaps lessened at the field scale with known technologies. National-level intensification strategies and input and output market development are proceeding rapidly. However, farmers and pastoralists are constrained by a variety of on- and off-farm factors from adopting such technologies and continue to suffer from risk from limited and variable rainfall along with competing demands for water, biomass and nutrient resources.  Introducing small-scale and supplemental irrigation in combination with nutrients in a landscape is one of the most transformative changes that can occur. Improved water management through supplemental irrigation and other agricultural water management options can reduce risk and stabilize productivity and even lessen yield gaps in farming and pastoral systems, and at the same time improve overall ecosystem services. Significant out-scaling of these options has been hard to achieve in development programs, though farmer driven small-scale irrigation is expanding rapidly in many countries in sub-Saharan Africa. With this expansion, there is a danger of losing critical landscape niches and their associated ecosystem services, such as wetlands. Furthermore, water quality may become degraded and access to irrigation may be limited thereby creating groups of winners and losers in a community.  On the other hand many options for balancing multiple goals, and supporting sustainability of gains through integrated green-blue water and integrated nutrient management are possible, if they are identified and articulated in planning processes. For example, in order to achieve sustainability without off-site impacts, variability in water availability in space and time, and impacts of out-scaling can be taken into account when designing intervention strategies. |
| Intermediate Development Outcome   1. Improved water and nutrient management in rainfed landscapes reduces risk of crop failure, reduces unproductive losses of water, increases overall biomass production, income, and ecosystem services to secure and sustain the livelihoods of farmers. |
| Research outcomes   1. Water resources development plans of government and development donors include and finance a range of small-scale water management options, include attention to required nutrients or soil amendments, and provide incentives for adoption. 2. Planning departments incorporate meso-scale water resources assessment and ecosystem services objectives into planning processes. 3. Development implementers design and adopt incentive systems that lower uncertainty and support beneficial change in target landscapes. 4. National agricultural intensification strategy frameworks (such as CAADP), and poverty reduction strategies, and CGIAR research programs and partners use improved quantification of yield gaps, associated indices and landscape evaluation tools to prioritize and target interventions. 5. Understanding factors involved in decision-making of men and women farmers and youth is incorporated into intervention recommendations for specific landscapes. 6. Planning and implementation of water resources development takes account of larger scale and off-site impacts on affected people and ecosystems |
| Research outputs   1. Lessons from factors influencing and enabling farmer-driven initiatives in agricultural intensificaiaton, to enhance the productivity of these systems and achieve scale. 2. Improved landscape and yield gap assessment tools, including soil and water information that underpin sustainable intensification strategies, and assist in targeting scalable agricultural water management and appropriate soil management interventions. 3. Intervention packages and adoption frameworks integrated solutions to increase eco-efficiency of production systems and enhance ecosystem services and livelihoods. 4. Tools for analyzing tradeoffs and ecosystem services monitoring in landscapes; analysis of landscape impacts of solutions including conservation agriculture, fertilizer micro-dosing, integrated soil fertility management, biological nitrogen fixation, and watershed development; 5. A matrix of factors affecting farmers’ choices and inhibiting intensification; institutional analysis at multiple scales; analysis of policy formation and implementation to design incentive systems that support sustainable land management. 6. Policy advice to secure rights to water and land and create incentives to optimize agricultural water management in agro-ecozones without damaging the ecosystem or creating negative impacts on off-site or downstream users of water. 7. Engagement with actors at various scales in target countries (CAADP teams, IFAD programs and others) to develop pathways towards eco-efficient intensification in landscapes. |